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Perceptual and Acoustic Voice Analysis in Hyderabad City, India with Sports Coaches



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ABSTRACT

Professional voice users are individuals who are directly dependent on vocal communication for their livelihood. Sports Coaches depend heavily on their voices at work to give instructions and commands. Because of this, such individuals are prone to develop voice problems. This study investigates the voice problems in 20 Hyderabad sports coaches by analyzing the acoustic parameters of voice [frequency, jitter (%), shimmer (%), Mean Fundamental Frequency (Mean F0), Harmonic to Noise Ratio, Phonation time (in seconds)] using Praat (Version 5.4.08) software and quality of life related to voice usage were assessed using Voice Handicap Index (VHI) in comparison to 20 normal voice users. The results reveal significant difference in voice parameters between sport coaches and normal voice users both perceptually and acoustically. Thereby, emphasizing the need for voice therapy and vocal hygiene to prevent voice problems in Indian sports coaches.

INTRODUCTION

A well functioning voice is a must for most of the people and is an indispensable apparatus of daily life. Few individuals are directly dependent on vocal communication for their livelihood. They are classified as “Professional Voice Users”. These individuals by the very nature of their occupations are at greater risk for developing voice problems and laryngeal pathologies. Professional voice users include singers, actors, announcers, sports coaches, Dubbing artists, teachers, receptionist, sales persons, lawyers, telephone operators, politicians, medical transcriptionist.

Many studies have identified an association between type of employment and the development of voice disorders. Teachers/sports coaches are considered among those at a risk for vocal disability. Prolonged voice use through verbal instruction, in the presence of background noise, has been implicated as a cause of vocal impairment among members of this profession. The sports coaches use high levels of habitual energy to increase vocal loudness and communicate with high degree of sensitivity, awareness and concentration which makes them susceptible to functional voice difficulties.

Recent studies reports that sports coaches experience vocal fatigue soon after beginning their careers. Those who teach physical education are especially prone to the effects of vocal fatigue. In many cases, the condition progresses from year to year. Eventually, the severity of the symptoms reaches a point where it is difficult, painful, and even impossible to continue guiding through the end of the academic day, weak or year. Data from different studies indicates the prevalence of voice problems among sports coaches to be from 20% to 50%⁴. The current study investigates the acoustic measures as well as quality of life related to voice usage in sports coaches of Telangana region in comparison to normal voice users.

MATERIALS AND METHODS

Participants

The experimental group (Group A) consisted of 20 male professional sports coaches within the age range of 20-50 years with mean age of 43 years who were selected from academy and practice facilities or stadiums having experience in sports coaching for minimum 4 years to maximum of 10 years. The control group (Group B) consisted of 20 male normal voice users

in the age range of 20- 50 years with mean age of 35 years and Prior to the evaluations, consent of participants was obtained.

Instrumentation

The acoustical assessment was done by using Praat Voice Analysis Software (Version 5.4.08). The acoustic parameters measured were Habitual F0 (Hz), Jitter (%), Shimmer (%) and Mean Fundamental Frequency (Mean F0) (Hz), Maximum Phonation Duration and HNR ratio. A hand held portable miniature unidirectional electret condenser lavalier type microphone named Ahuja UTP 30 Microphone was used for the purpose of recording voice samples which was connected to Dell Laptop (with Intel i5 processor). Perceptual assessment of voice was administered using VHI questionnaire. To measure the voice related quality of life the VHI is used (Jacobson et al., 1997). This questionnaire is about the subject's perception of his or her own voice use and possibilities. The VHI is a questionnaire with 30 questions where the subject is requested to check a box in a five point scale on three different categories, physical, emotional and functional. For the answer 'never' a score of zero points and for 'always' four points is given. A total of 120 points can be acquired if all questions are answered with always.

Recording

Recording for experimental group and control group were done in a relatively quiet environment and in a single sitting. The subjects were asked to be seated comfortably and instructed to take a deep breath and phonate /a/ for as long as possible, take a deep breath and phonate /i/ for as long as possible. And take a deep breath and phonate /u/ for as long as possible. A hand held portable miniature unidirectional electret condenser lavalier type microphone named Ahuja UTP 30 Microphone was used for the purpose of recording voice samples which was connected to Dell Laptop (with Intel i5 processor). Both the groups, Professional Sports Coaches (Group A), and normal voice users (Group B) voice samples was recorded using dell laptop with a Microphone held at 6 inches from subjects mouth and samples are saved in .wav format. Three samples for each sustained phonation such as /a/, /i/ and /u/ were recorded and the best of the three samples for each sustained phonation was taken into consideration and was analyzed for the purpose of voice analysis.

Acoustic analysis

The phonation samples of both the groups recorded were analyzed in PRAAT (version 5.3.30) software. The first and the last 2 seconds were ignored from the samples and the steady centre portion was taken for analysis. The parameters are obtained and are tabulated separately for the samples /a/, /i/, /u/ and for both the experimental & control group. Mean and standard deviation was calculated for each component of the acoustic data /a/, /i/, /u/

Statistical analysis was done using statistical package for social sciences version 17.0 to obtain descriptive statistical measures such as mean and standard deviation in both groups.

RESULTS AND DISCUSSION:

The acoustic and perceptual voice parameters were compared across experimental group and control group. A repeated measure of ANOVA (Analysis of Variance) was done to compare voice parameters across experimental group and control group obtained from PRAAT and VHI.

Acoustic Voice in Professional Indian coaches

Table 1: Mean and standard deviation acoustic parameter /a/, /i/ and /u/ in professional voice users

Acoustic parameters of professional sports coaches		/a/	/i/	/u/
Max. F ₀	Mean	133.74	133.7	133.83
	Standard deviation	4.78	4.73	3.64
Jitter /a/	Mean	1.26	1.14	1.28
	Standard deviation	0.41	0.39	0.39
Shimmer /a/	Mean	3.09	3.14	3.02
	Standard deviation	0.69	0.68	0.65
MPT	Mean	12.87	12.87	12.03
	Standard deviation	0.83	0.86	0.95
HNR	Mean	20.43	21.07	22.71
	Standard deviation	5.12	4.95	2.04

Mean and standard deviation of fundamental frequency, jitter, shimmer and harmonic to noise ratio, maximum phonation time in professional sport coaches and as normal voice users for /a/, /i/ and /u/ were obtained

Table 2: Mean and standard deviation acoustic parameter /a/, /i/ and /u/ in normal voice user

Acoustic parameters of normal voice users		/a/	/i/	/u/
Max. Fo	Mean	131	130	130.5
	Standard deviation	3.60	2.38	2.2
Jitter/a/	Mean	0.58	0.61	0.59
	Standard deviation	0.28	0.24	0.59
Shimmer/a/	Mean	2.65	2.42	2.45
	Standard deviation	0.585	.56	0.46
MPT	Mean	14.06	13.79	12.86
	Standard deviation	0.33	0.96	1.10
HNR	Mean	24.68	22.61	21.12
	Standard deviation	2.84	0.63	0.8

Results from Table 2, showed that there is a significant difference in fundamental frequency between the professional sport coaches and as normal voice users for /a/, /i/ and /u/, all the three vowel [F (1, 38) = 16.420, (p < 0.001)]. Higher mean of fundamental frequency was obtained for experimental group in comparison to control group for phonation samples of /a/, /i/ and /u/.

Studies also have suggested the voice changes in terms of fundamental frequency in sports coaches during work. A study by Rantala et al (2000) is in consensus with the present study. Subjects consisted of 33 males from sports academy who recorded their first and last session during commanding time. The subjects were studied both as one group and two subgroups (those with many and those with few voice complaints). Estimates of fundamental frequency (F0), Sound Pressure Level (SPL), the standard deviations of these values (F0, SD, SPL SD) and F0 times (vibration time of vocal folds) were recorded. The results of this study showed that some voice features changed during the commanding. The changes were not, however monotonic. They were not the same during the period and all variables and the changes were different in the subgroups. The most obvious and uniform changes were seen in F0, it increased toward the end of working day.

Results also showed that there is a significant difference in Jitter between the professional sport coaches and normal voice users for /a/, /i/ and /u/, all the three vowel [f (1, 38) = 54.050, (P < 0.001)]. As can be seen from figure 2, jitter was always higher in all samples /a/, /i/, /u/ in professional sport coaches' comparison to normal voice users.

Few empirical data are also available on changes in F_0 , jitter and shimmer, induced by vocal loading in teachers. Rajasudhakar and Savithri (2009) did a study in five primary school teachers, reported after 6 hours of teaching that the F_0 of phonation and speaking fundamental frequency were increased compared to the pre-teaching (baseline) condition. Thus, indicating change in acoustic voice parameters change in professional voice users.

There is a significant difference in Harmonic to Noise Ratio between the professional sport coaches and as normal voice users for /a/, /i/ and /u/, all the three vowel [F (1, 38) = 34.814, (p < 0.001)]. Harmonic to Noise Ratio was less in all samples /a/, /i/, /u/ in professional sport coaches' comparison to normal voice users. There is a significant difference in shimmer between professional sports coaches and normal voice users [F (1, 38) = 17.275, (p < 0.001). Shimmer was always higher in all samples /a/, /i/, /u/ in professional sport coaches' comparison to normal voice users. Maximum phonation time was observed between in professional sport coaches' and normal voice users. The professional Indian coaches had less maximum phonation duration in comparison to normal voice users. The voice parameters which differed from normal will help us to identify early deviations and help in choosing proper remedy for it. Therefore, sports coaches as a professional voice group should be considered for voice training and vocal hygiene programs.

Perceptual voice analysis in professional Indian coaches

Voice handicap index was done to understand the perceptual characteristics of voice problems. It consists of physical domain, functional domain and emotional domain.

Table 3: Mean and standard deviation of voice handicap domains in professional sports coaches and normal voice users

Parameters	Subjects	Mean	Std. Deviation
Physical	Professional Sport Coaches	12.8	1.43
	Normal Voice User	4.8	2.166
Functional	Professional Sport Coaches	13.85	1.682
	Normal Voice User	5.55	1.538
Emotional	Professional Sport Coaches	13	1.585
	Normal Voice User	4.05	1.93

Physical Domain analysis

Results of T-test showed significant difference between professional sport coaches and as normal voice users at 1% level of significance [$t(38) = 21.874$ ($p < 0.01$)]. Physical problem was found to be higher in professional sport coaches and when compared to normal voice user. The VHI score are matching with previous study done in teachers by Smith et al (1998) compared the frequency and effects of voice symptoms in teachers to a group of individuals employed in other occupations. Teachers were significantly more likely to report having a voice disorder to experience more specific symptoms of voice related physical discomfort.

Functional Domain analysis

Results of T-test showed significant difference between professional sport coaches and as normal voice users at 1% level of significance [$t(38) = 35.687$ ($p < 0.01$)]. Functional problem was found to be higher- in professional sport coaches and when compared to Normal Voice User.

Emotional domain analysis

Results of T-test showed significant difference between professional sport coaches and as normal voice users at 1% level of significance [$t(38) = 54.335$ ($p < 0.01$)]. Emotional problem was found to be higher in professional sport coaches and when compared to normal voice user. Professional Sports Coaches face situations involving emotions and feelings of anxiety, unhappiness, impatience, and tensions generated from the relationships with the players, especially in actions of calling attention, warning and reprehension, worsened by the stress of competitions. The emotions and states of anxiety and stress are ergonomic factors of vocal risk, since they produce physiological changes in the body, speech and voice, and generate vocal complaints and symptoms and are harmful to voice-related quality of life.

De Jong et al (2003) describe four different types of causes for occupational voice problems. The problems can be due to physical, functional, psychological and environmental factors. Thus voice handicap index results indicate professional sports coaches have physical, functional and emotional voice problems which indicate.

CONCLUSION

The present findings highlight variation in voice parameters in professional sports coaches in comparison to normal voice users. The presence of voice problems can be due to vocal behaviors such as speaking in strong loudness and yelling, which are part of a pertinent and necessary vocal psychodynamics in the context of the relationships and work dynamics of the involved subjects. Literature considers that these abusive, negative and deleterious behaviors actually lead to a vocal abuse situation that leads to overload and may result in signs and symptoms such as vocal wear and strain, swelling, edema and inflammation of the larynx. Professional Sports Coaches have insufficient vocal care. A study done by Kooijman et al (2006) found that more than 50% of the Dutch teachers have or had a voice problem and in 20% of the cases these problems lead to a sickness absence from at least three days. Hence worsening of voice problems can lead to their absence. Therefore there arises a need for guidance in these individuals for the promotion of health and vocal well-being. Concerning vocal health and well-being, the complaints expressed on the interviews involve hoarseness, strain, discomfort, tiredness and voice loss, dryness, phlegm and difficulties in voice projection. These complaints correspond to those found in studies with Physical Education Instructors with Sports Coaches. The clinical implication of the study is, it provides useful information regarding voice characteristics in sports coaches. The outcome of the study will aid in assessment of voice disorders in sports coaches. The outcomes will also assist the Speech pathologists/voice pathologists in planning the professional voice coaching program during the management. Limitations of the study are that it was conducted only on the male subjects. Study has been carried out on a very small group so it cannot be generalized.

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